Coastal Erosion: Strategies for Alaska

Proceedings of a Workshop April 11, 2007

International Arctic Research Center, University Alaska Fairbanks

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University of Alaska | The Denali Commission

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Abstract

A one-day workshop was held at the International Arctic Research Center at the University of Alaska Fairbanks on April 11, 2007. Using a series of targeted briefings and discussions the invited group of coastal specialists arrived at a series of recommendations that outlined a need for sediment budget analysis, education and outreach efforts, establishment of a state-wide advisory committee, and the establishment of an information and project clearinghouse. This meeting represented a kick-off event for the University of Alaska's International Polar Year Science Subcommittee forum, North by 2020 and was sponsored by the Denali Commission and the University of Alaska statewide system.

Introduction

The problem of coastal erosion is endemic in Alaska. With 80% of the state's population and 30,000+ miles of coastline, it is a problem that must be addressed. This is even more pressing in the face of rapid environmental changes observed in marine and ground ice, that exacerbate the problem. Many meetings and studies and much activity and expense has been directed at this issue for many years, yet we remain facing a continuing string of dire community situations.

This workshop was convened to bring together a cross-section of experts from around the state to explore a range of approaches, hard and soft, for dealing with coastal degradation, narrow likely ways forward, and to then assemble this information into a series of recommendations.

The focus is to remain tight, to build on rather than compete with other, similar efforts that have already taken place, such as the Coastal Erosion Responses for Alaska workshop, held January 4, 2006 at the University of Alaska Anchorage.

IPY and North by 2020

As of March 2007, the International Polar Year has just commenced. This is an important intellectual and philosophical touchpoint to bear in mind. Two of its principal legacies apply directly to this situation: bringing together diverse group of experts to tackle a problem, and engaging education and outreach to empower non-specialists and so leverage our efforts. The University of Alaska's IPY Science Subcommittee devised the concept of a forum for international cross-disciplinal information exchange. The forum, North by 2020, in turn identified several themes and theme leaders for more specific action. Coastal Infrastructure is one of these themes. This workshop represents an inaugural event for this theme and for the forum. The greater strength of what we do here is to take another step in relying on the expertise of one another and to seek out exchanges of information with each other abroad, because other nations suffer from the same problems. We can not work in isolation on a problem like this – as a researcher or as a nation.

Workshop Objectives and Strategies

The workshop will commence with a series of overview talks concerning environmental forcing issues, hard engineering solutions, and a planning overview. Much of this discussion will center around overviews of the efforts of the US Army Corps of Engineers, the main general contractor for coastal intervention work in Alaska.

The second half of the workshop will focus on what strategies might be adopted in the near and farther term to a) try to get this problem reduced in the long term and b) line up erosion response strategies when intervention is required.

This material will be gathered into a workshop report. The talks will be placed online for reference. <http://people.iarc.uaf.edu/~datkinson/coastal_strategies/>

Workshop opening remarks and direction

D.E. Atkinson (International Arctic Research Center/University of Alaska Fairbanks)

I'd like to welcome everyone to the "Coastal Erosion: Strategies for Alaska" workshop here at the International Arctic Research Center at the University of Alaska Fairbanks. It has been my pleasure to help set up this workshop, in conjunction with the workshop co-organizer, Professor Orson Smith of the School of Engineering, University of Alaska Anchorage.

This effort represents one of the first events sponsored by the University of Alaska system, with generous assistance from the Denali Commission, to launch the International Polar Year. Under the leadership of Craig Dorman, Statewide Vice President for Academic Affairs and Research, and Professor Hajo Eicken, Chair of the UA IPY Science Subcommittee, this event was envisioned as part of a new forum, North by 2020, set in motion, and today brings together this group of minds to focus on a serious issue that threatens many in our state.

Our meeting here today will be fast moving and to the point. Everyone present is fully aware of the situation along many of Alaska's coastlines; we will not dwell on those details. Instead, our mandate is to, in the first part of the meeting, highlight in presentation form projects that are underway that will improve the information available concerning the coastal situation that can support efforts to find solutions. Next will be a series of briefings by Orson Smith, Yvonne Kopy, Steve Hughes and Ken Eisses, that will cover a range of options for coastal protection, from hard-engineering solutions through to local planning tools designed to mitigate problems before they occur.

At lunch I am pleased to have Bruce Sexauer brief us on the Army Corps' "Baseline Technical Erosion" study.

Freshly armed with these options in the afternoon we will embark on three, focused discussion sessions. The first session will cover your perceived needs regarding data requirements to support options discussed, the idea of a possible pilot project to examine various options in a controlled setting, how to get information out to people, and what sort of funding venues exist that could be tapped. In the second session I hope to explore the idea of information for public awareness – what is required and what form this could take. Finally, in the third session, I'd like to try to prioritize from the list projects identified, see if there are any options already in the works that could somehow be leveraged, and design a means to implement the ideas discussed.

Such efforts are not singular, and at this point I would very much like to thank Craig and Hajo for their insight, their networks, and keeping this effort linked into the broader perspective. Orson, my main collaborator, brought his formidable experience and contact resources to bear and is responsible for suggesting many of you who are here today.

Welcome to Fairbanks!

Summaries from presentations

Coastal Erosion Solutions: Supporting Efforts
(D.E. Atkinson)

This presentation provided an overview of several projects currently underway that are mandated to improve forecast capacity and to bridge the gap between research knowledge and applications. Several of these projects share a strong multi-disciplinary structure, allowing the various relevant research branches to communicate directly with communities and with each other. Most of these projects are funded by the National Oceanic and Atmospheric Administration (NOAA), which is taking a keen interest in improving the detail and accuracy of their coastal zone forecasts and expanding the relevancy of their mandate to work towards, for example, including estimates of erosion.

Arguably at the heart of coastal solution-building is the need for detailed weather and climate forcing information. For example, average and maximum seasonal wave energy information must be available before coastal defense works can be constructed. However, in the Alaska region NOAA efforts are hampered by a lack of detail in their coastal wave models. To this end NOAA is supporting two projects that target improving our understanding and our forecast capacity of waves, wind and precipitation in the coastal zone.

First is the Pacific Region Integrated Data Enterprise (PRIDE). For the Alaska region, the mandate of this project is to improve NOAA wave forecast capacity in the coastal zone. This effort represents a partnership with the Environmental Protection Agency (EPA), who are also very interested in this topic and who recently began providing direct support to the NOAA PRIDE effort.

The second effort is the Pacific Region Integrated Climatology Information Products (PRICIP). Members of this project are working with community stakeholders to design delivery systems for summary information that are of greater relevance to their needs, than for example, the standard National Weather Service forecast products. An example target product is detailed return intervals for severe wind events for the coastal regions of Alaska and Hawaii, derived from both weather station data and model data. Output is being aimed at more modern delivery methods, including interactive, on-line geographic information system (GIS) tools and GoogleEarth®. Output products from this effort are envisaged to serve groups as diverse as, for example, coastal planners and recreational users.

An important additional objective of both projects is to improve links between Alaska and Hawaii, the idea being that both states are essential coastal in demographics and outlook, and both states tend to suffer from a comparative lack of funds, relative to the conterminous US.

Two other NOAA-supported efforts possess a much more direct mandate to engage a spectrum of disciplines linked by their common coastal focus.

The first is the Social Vulnerability to Climate Change and Extreme Weather in the Alaskan Coastal Zone. The mandate of this project is to determine the specific sensitivities of coastal communities to climate and weather and to then link this knowledge into larger-scale weather and climate models to improve predictability in the short term and trends estimates in the long term.

This effort brings together the following units at the University of Alaska Fairbanks:
- Department of Anthropology
- School of Fisheries and Ocean Sciences, Marine Advisory Program
- Atmospheric Sciences Program
- Geophysical Institute
- International Arctic Research Center

Direct work in several west coast communities is being undertaken, as are literature reviews to locate previous studies focusing on subsistence use and climate impacts.

The second is the Alaska Center for Climate Assessment and Policy (ACCAP), the name given to the NOAA Regional Integrated Science Assessment project in Alaska.
This project has several mandates:
- assess the socio-economic and biophysical impacts of climate variability in AK
- make this information available to local and regional decision-makers
- improve the ability of Alaskans to adapt to a changing climate

These projects are in communication with each other to avoid overlap.

An important international effort that has contributed much to the study of arctic coastal processes is the Arctic Coastal Dynamics project, now in its seventh year. This group of researchers has contributed much to our understanding of coastal dynamics in a region with ice in both the marine and terrestrial environment. This project has also contributed a lot of baseline information in the form of coastal information database stored in a geographic information system format.

The School of Engineering at the University of Alaska Anchorage has run an annual series of workshops that center around the theme "Science to Engineering" – essentially getting research results to the applied public. In 2006 the focus of the workshop was on Coastal Erosion issues.

Finally, there are ongoing efforts to direct more funds towards this issue. Proposals have been submitted or are in the works to NASA, NSF, and NOAA.

Coastal Erosion Responses for Alaska
(O. Smith, M. Hendee, UAA School of Engineering)

Orson Smith, School of Engineering, presented an overview of coastal processes and how they operate. There are a variety of coastal hazards in Alaska, including:

- coastal flooding
- high winds
- erosion
- earthquakes
- tsunamis
- sea ice

Coastal flooding is generally, but not always, associated with surges. A surge, or temporary increase in water level beyond that accompanying the tidal regime, is caused rarely by tsunami or, more typically, by wind setup accompanying storms. Winds do not have to be particularly strong to cause surges. The primary prerequisites are persistence of wind direction and adequate fetch, or long lengths of open water. The final prerequisite is on-shore direction; persistent off-shore winds can cause a negative surge, or temporary decrease in sea level. The angle of wind direction with respect to coastline orientation is also important – a maximum surge can generally be expected when wind direction is perpendicular to the coastline.

Despite the significance of flooding and surges as a coastal hazard, waves are the primary force acting on the coast. Their capacity to move material is by far the primary source of coastline re-working. Waves represent the dominant coastal erosion problem around the world, Alaska included. Similar to water level surges caused by wind-setup, the transfer of wind energy into the water creates waves as it moves over the water. Wave height varies directly with each of wind speed, fetch, and duration. The kinetic action of waves liberates sediments from the soil matrix, introducing them into the water column where they can be transported. This tends to occur in the surf-zone, near the beach. Heavy waves, such as those associated with storms, move sediment off-shore. Longer periods of moderate waves that occur with the more prevalent, "background" wind regime, tend to move sediments back on-shore. This results in a fairly typical pattern seen in many regions of the world, in which the period of heavier erosion is winter, and the period of shore-face rebuilding is summer. When waves break obliquely sediment is moved long-shore, that is, transported parallel to the beach face.

The wave regime at a particular location is very dependent on site-specific characteristics that include coastline orientation, off- and near-shore bathymetry, beach face and profile, back-shore profile, bluff height, soil material, and in the arctic, ground ice nature and content. Classic "textbook" wave patterns are complicated by the presence of ice in the marine and terrestrial environment. Permafrost exhibits great strength when frozen; often coastal permafrost bluffs can be undercut by many feet. Ice rich terrain is also susceptible to thermal erosion, which complicates understanding based on wave energy alone. Permafrost regions are also susceptible to subsidence when they undergo thawing. Furthermore, on top of this complexity, time and again it has been demonstrated, in the arctic and elsewhere, that disrupting natural coastal processes almost always makes things worse.

Fig 1: Pocket beach on Elrington Island, Prince William Sound. Photo by Riley Smith

Fig. 2: Alluvial fan at Lowell Pt. near Seward
Photo by Dan Ottenbreit

Fig X3: Unconsolidated bluff at Kenai. Photo by Orson Smith

Alaska possesses a variety of beach and shoreface types that result in a variety of erosional responses. These are summarized below:

Southeast, southcentral Alaska (Figs 1, 2)

- Fjords and rock promontories
- Steep pocket beaches of sand and pebbles, or
- Alluvial fans – bulbous deposits at stream mouths
- Subject to high tidal range
- Respond mainly to storms
- Comparatively slow erosion rates

Southwest Alaska (Fig. X3)

- Bluff shorelines
- Mostly unconsolidated glacial deposits
- Sand and gravel beaches at base
- Typical of Cook Inlet, Kachemak Bay and Bristol Bay
- Bluff erosion feeds sediment to beaches
- Isolated catastrophic retreat due to wave-induced undercutting
- Weakened by bluff-edge development, runoff concentration, and foot or vehicle traffic

West Alaska (Fig. 4)

- Deltaic shorelines composed of fine-grained sediments covered with tundra
- Primarily located in western Alaska
- Wide beaches comprised of fine sand and silt
- Low coastal plains of discontinuous permafrost subject to thermal erosion and thaw subsidence

Permafrost shorelines (Fig. 5)

- Northwestern and Arctic Alaska
- Low tide range
- Narrow sand and gravel beaches at base of low bluffs
- Permafrost of ice, organics, and fine-grained sediments
- Subject to thermal erosion & thaw subsidence
- Most eroded matter lost with little contribution to beaches
- Dramatic erosion during late summer and early fall storms

Fig. 4: Deltaic lowland near Hooper Bay on Bering Sea. Photo by James Hoelscher, © Alaska Community Database, ADCED

Fig. 5: Eroding permafrost bluff, Elson Lagoon, Barrow. Photo by Orson Smith

Controls and Response

There are various options that may be considered when faced with erosion problems.

> *Move*. The simplest in concept is to move out of the way. This is what may be thought of as an "a posteriori" response.
>
> *Know before you buy*. Simpler still is to "know before you buy" – find out if this is an erosion-susceptible setting. This sets the stage for an education requirement.
>
> *Zoning*. Borough-mandated planning legislation is another option – set-back ordinance can force builders to act sensibly.
>
> *Build to withstand*. A knowledge of the wave and surge regime, combined with proper design and materials, can allow for building that directly resists wave and surge action.
>
> *Retreat*. This is essentially the move option, although it suggests that the site will not be abandoned. In this case information is needed to answer the question "where to?".
>
> *Beach nourishment*. This requires a significant source of material that should not be taken from farther offshore.
>
> *Vegetation stabilization*. This is a slower implementation solution that is more effective at the upper ends of beaches, i.e. and not the lower beach. It is also more effective when it forms one of a series of solutions.
>
> *Revetment*. Revetments are designed to dissipate wave energy. They are constructed of heavy interlocking armor and require an appropriate filter to prevent scour between the armor units. Toe protection is also required.
>
> *Seawalls*. Seawalls are more massive vertical structures of concrete or stone masonry that require a solid foundation base and lateral structural support.
>
> *Bulkheads*. Often also called seawalls these are typically steel sheetpile retaining walls. This type of structure increases reflective wave energy and require toe protection to prevent scour.
>
> *Offshore Breakwaters*. These look like a discontinuous wall constructed offshore to dissipate wave energy. Requires stable armor material (rock or concrete). Erosion may be accelerated at margins.
>
> *Beach Groins*. Walls constructed perpendicular to the shore to trap sediment moving longshore. These strongly affect material transport, tending to accrete sediment on up-drift side while starving areas immediately down-drift.
>
> *Gabions*. These consist of wire-mesh baskets filled with cobbles or sand-bags. Advantages of gabions include transportability and the fact they represent a low-tech, low-skill alternative to large rock or concrete. They can be wired together to form an interlocking retaining wall. Problems with this approach include degradation of the wire due to salt-water corrosion and of the geotextiles due to sunlight as well as basket distortion due to ice and wave action. Wire from failed gabions is hazardous.

Various problems exist with the sea wall solution. They are very susceptible to toe scour, that is, increased depth at wall, if great care is not taken during planning and construction. The beach width fronting the seawall is always shortened. Flanking, or end effects are common as waves refract around the ends of the wall.

Finally, there are various additional concerns specific to the Arctic. At many locations thin sea ice can get driven ashore by the wind, where it can pile up. Thicker ice has more of a bulldozing action that instead results in a build of a rubble berm. Ice run up can be mitigated by introducing a convex beach profile. This causes a break in the ice profile which forces ice to pile up before getting too far inland. Regarding constructed solutions, freeze-thaw cycles can prematurely degrade construction materials and ice that gets into fill during construction can melt in the summer, resulting in subsidence and possible structure failure.

A Planning Response to Erosion Issues
(Y. Kopy)

Yvonne Kopy, a planner with the Bristol Bay borough presented an overview of the situation in the Bristol Bay area as well as issues faced when the operational reality of planning squares off against erosion issues. The Naknek River serves as a microcosm of the broader coastal erosion issues across the state. Although broad categorizations can be made, the actual erosion situation varies greatly from one location to the next, often on a scale of hundreds of feet. It can also be more complex where a river meets the sea. In that case erosion can be caused by the river or by the sea. The Naknek river shoreline presentation ranges from almost sheer bluffs ~70 feet in height (Fig 6) to low areas almost flush with the river.

Fig. 6 – typical bluff along the Naknek River. Note the exposed septic tank and house above the bluff for scale and for a sense of the magnitude of retreat. (photo by D. Atkinson)

This region underscores the need for a general educational outreach effort. People in this district continue to make decisions that are in clear contravention of what should be done given the situation presented to them. A good case in point concerns the owners of the house just visible in Fig. 6 – they purchased the house only recently. The region, however, has a clear history of erosion – directly above the photographer there once ran a road.

Fig. 7 – Example of an attempted bluff stabilization solution taken in ignorance. I this case removing the trees weakens the slope by removing an anchor. (photo by Y. Kopy)

A strong planning option was discussed – the idea of legislation to prevent building from occurring. Typically known as setback legislation, these bylaws force owners to make more intelligent property decisions by forbidding occupancy within a certain distance of a clearly unstable slope. Although a sensible response, Kopy related her experiences at trying to implement this sort of legislation in Bristol Bay, and how she is met with active opposition. Coming back to the education theme, Kopy also related other experiences in this region, including the variety of responses individual owners undertake in a bid to stave off erosion. For example, one individual bulldozed all the vegetation off the lot and pushed it down the bluff, to act as a buffer, not realizing that the trees were providing greater service as living anchors (Fig. 7)

Setback legislation is an example of a mitigation solution – it does nothing to prevent erosion, but it mitigates the problems associated with it, namely, loss of infrastructure. A challenging sidelight of this is that surrounding insurance, and the extent to which an insurer should be responsible when there is the clear presence of risk.

Constructed Shore Protection
(S. Hughes, presented by K. Eisses)

Ken Eisses (US ACE AK district) presented the talk prepared by Steve Hughes of the Coastal and Hydraulics Laboratory at the US Army Engineer Research and Development Center. This talk concerned specific engineering aspects of different types of shoreline response. One of the first points made echoed what Kopy stated, that the diversity of coastal types encountered guarantees that there is no one solution. Hughes pointed out that, for some areas of Alaska, long-shore drift goes both directions. All projects undertaken by the Corps are unique to their particular setting. Another important point is that there is no permanent solution. All defensive works must be maintained. This is a point that is often times lost.

Hughes focused on two categories of shore protection alternatives – armoring and stabilization – and shore protection project planning.

Similar to Smith, Hughes laid out the general list of response options:

- Armoring ("draw the line")

• Moderation (“slow the loss”)
• Restoration (“fill it up”)
• Adaptation (“live with it”)
• Abstention (“do nothing,” “abandon”)

Under armoring are a series of structure types, including seawalls, bulkheads, and revetments/dykes. An important feature common to these structures is high cost. Another important feature is a certain degree of irreversibility – once started down that path it is very difficult to restore a shore to its original state. General definitions of these alternatives are:

Seawall: Seawalls are vertical structures, constructed parallel to the shoreline that separate land and water areas, and are primarily designed to prevent erosion and other damage due to wave action.

Bulkhead: Bulkheads are vertical structures that are designed primarily to prevent sliding or retention of the land. A secondary purpose is to protect upland areas against damage from wave action.

Acceptable construction materials for seawalls and bulkheads include timber, sheetmetal, vinyl, and concrete. Design considerations must balance functional performance, structural stability, and minimization of collateral impacts. Some undesirable impacts include frontal effects (increase in toe scour and depth at wall), end-wall effects (flanking), blockage of littoral drift when projecting into surf zone, and decreased beach width fronting the seawall. Several of these impacts will affect neighboring properties and so any shore intervention project must be conceived with care. Note that collateral impacts is an important consideration for any type of coastal intervention.

Revetment: Revetments are shoreline structures constructed parallel to the shoreline and generally sloped in such a way as to mimic the natural slope of the shoreline profile and dissipate wave energy as the wave is directed up the slope.

Dikes and levees: Dikes and levees are mounded structures, made of natural or man-made materials, built around low lying areas to prevent flooding

Acceptable construction materials for revetments and dikes include armor stone (riprap, or large rocks), geosynthetic fabric, gravel/filter stone, concrete, or marine mattresses. Note that for most designs multiple materials are required, e.g. for an armor stone riprap coast a gravel/filter stone sublayer in turn underlain by geotextile will almost certainly also be required.

Shore stabilization is a moderation technique. Rather than trying to interpose a physical barrier between the waves and the land these techniques use strategically place structures to encourage retention of beach material. Various structures and arrangements are available:

Groins: Groins are manmade structures constructed perpendicular to the shoreline that are designed to help create or widen beaches by capturing sand moving along the shoreline (littoral drift). A variation on this is a T-Head Groin, which is a groin with an additional, transverse segment at its ocean-ward end. Possible construction materials include stone, concrete, timber, steel sheetpile, and geotextile tubes.

Breakwaters: Breakwaters are large scale structures constructed seaward of, and usually parallel to, the shoreline. They form in effect a discontinuous seaward wall. They attempt to break incoming waves before they reach the shoreline. A variation on this is the Reef Breakwater, which are smaller, submerged rubble structures constructed seaward of, and usually parallel to, the shoreline. They provide less protection than emergent structures, but they do not obstruct the view. Possible construction materials include stone, concrete, and geotextile tubes.

Sills and Perched Beaches: A form of a “stepped” beach in which a beach sill, constructed parallel to the shoreline, traps sand brought in by wave action or by man (beach nourishment or filling).

Hughes laid out the basic steps in a project planning process:
1. Specify problems and opportunities
2. Inventory and forecast conditions if no action taken
3. Formulate alternative plans
4. Evaluate effects of each alternative plan
5. Compare alternative plans
6. Select alternative(s) to carry on to design phase

He also emphasized two important points that have been iterated several times during the meeting: no solution is permanent, and all solutions require maintenance.

This talk represents an excellent reference source for a wide spectrum of non-passive engineering solutions accompanied by description and diagrams. Only a summary can be presented here; it is suggested that the reader refer to the on-line source of information at http://people.iarc.uaf.edu/~datkinson/coastal_solutions/hughes.pdf.

Alaska District Current Coastal Erosion Efforts
(K. Eisses)

Ken Eisses, Chief, Hydraulics/Hydrology Section of the US Army Corps of Engineers Alaska District presented selected erosion projects the USACE has undertaken in Alaska.

Shishmaref. Shishmaref represents a long-standing intervention project. Most recently in summer 2005 USACE installed 230 feet of rock revetment (cost: ~$1.4M) to combat severe erosion (Fig. 8).

Figure 8. Shishmaref, Alaska. Photo on the left taken July, 2004. Photo on the right taken October, 2004 after severe storm on October 11. Note the staircase leading to the teacher's quarters, circled in both images. In July 2004 there was about 30 feet of shore. (photos USACE)

This intervention represents the fifth or possibly sixth construction at this location. The substrate is composed largely of fine materials. This presents a problem because when the fines are washed away the revetment settles which leads to early failure. This occurrence is more likely during elevated water level events (surges), which are not uncommon. Thus an important consideration here is to ensure the stability of the fines substrate. This represents the first stage of a much larger effort that will see the protection extended in both directions along the coast. Thermistor strings were installed along the revetment profile to form the basis for an assessment of the effects of temperature on the revetment structure.

Barter Island. The effort at Barter Island focused on protecting a now-emergent air force landfill site that is scheduled for future removal and clean up. At this site large geotextile sandbags were placed to form a shallow-slope revetment structure.

Nome. At Nome the USACE constructed a 3,350 lineal foot rip-rap revetment structure in 1951. Using 8-ton rocks and receiving regular maintenance, it is an example of a shoreline protection structure that works.

Kotzebue. At Kotzebue a gravel-filled barrel revetment was installed in 1978-1979. This structure was generally successful but ultimately failed due to a) lack of concrete caps to prevent gravel loss and b) corrosion of the steel drums.

Barrow. A proposed structure has been designed for Barrow. One consideration at this location is the relative prevalence of ice-shove events, or ivus. Research work into structure designs that can handle/mitigate ice shoves has been ongoing. Ice-shoves occur in other parts of the US.

Eisses also discussed other possible solutions. One is a cast, inter-locking structure known commercially as "Core-loc". This is not suitable for coastal armoring but is designed for breakwater construction. It is being considered for a breakwater at Kodiak and went in at the Unalaska runway project in 2002. An important drawback with Coreloc is the requirement for a casting yard to construct the units.

Despite the potential utility of a sophisticated solution such as Coreloc, it is important to have off-the-shelf solutions when rapid intervention is required. Geotextile bags filled with gravel are a good, short-term solution that is also relatively low-cost, when local sources of aggregate materials can be secured (although the bags themselves can run $100/bag). Tests at the USACE Vicksburg facility suggest that gravel bags have an expected lifespan of 2-3 years, 5-7 with maintenance. A gravel bag revetment that is expected to be permanent requires annual maintenance; the bags are susceptible to puncture damage by ice and woody debris.

USACE Alaska District is also undertaking wave and surge climatology studies to obtain better guidance concerning return intervals for water level heights and energetic wave states.

Planning for the future of Erosion Management in Alaska: The Alaska Baseline Erosion Assessment and How to Plan for Erosion Issues in Alaska
(B. Sexauer, US Army Corps of Engineers, Alaska District)

Bruce Sexauer, USACE AK District, presented an overview of a multiyear project USACE Alaska is undertaking. Called the "Baseline Erosion Assessment" this project is a large-scale effort to document and prioritize erosion problems throughout the state (Fig. 9). The effort commenced with a survey of 150 communities that asked essentially "Do you have erosion problems?". This first phase has been completed. Based on an aggregation of responses that delineate the general severity and susceptibility to erosion the state has been divided into several sub-regions.

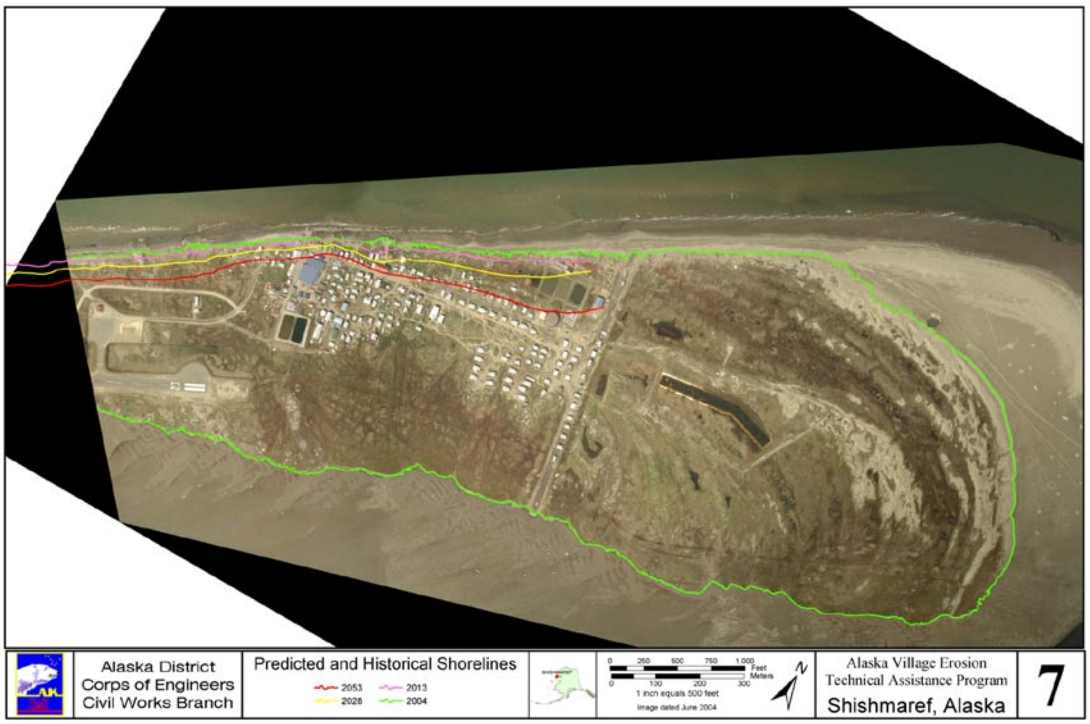

Figure 9: Predicted future shoreline positions on Sarachef Island (Shishmaref). Excerpted from the US Army Corps of Engineers' Baseline Technical Erosion Summary, spring 2007.

An important aspect of this assessment is a focus on the planning process. The planning process has three major components:

1. Assess problems and opportunities
2. Evaluate alternatives
3. Arrive at recommendations

Assess problems and opportunities
This phase relies on thorough and repeated contact with affected groups. It relies on uncovering their perception of the problems and opportunities. In the case of Shishmaref, which was the focus of a case study, this helped identify what is required for a solution. A plan was built, which then sets the stage for formal funding requests to enact the plan. An additional major challenge at this stage is to define the problem without presupposing the solution – an open mind must be kept.

Evaluate alternatives
In this phase the full costs of the alternatives are considered. This extends beyond the financial to encompass cultural and environmental costs. In the case of Shishmaref $1M was spent on a cultural case study. Although one straightforward solution is to relocate the village,

the full cultural cost must be factored in. In this case the cultural values of moving must be considered. This can make a comparison of alternatives especially challenging – ultimately the "worth" of culture must be implicitly quantified in the face of extrapolations dictated by the various hypothetical scenarios. Other considerations – will it endure? Will it ultimately protect what you want?

Recommendation
In this phase a difficult yet fundamental issue is how a recommendation is finalized. Plans developed at different levels of government – who pays for what? Any recommendation will involve a lot of people and expense.

The first phase of the Baseline Erosion Assessment is complete – regions have been prioritized by severity of need. The next phase of the project will take place in summer of 2007 when teams will go out to the communities to identify the problem, determine how long until critical, and begin developing alternatives.

Current plans for the three most serious cases are:

- Shishmaref – assist with further planning and construction
- Kivalina – shore up and plan for the future
- Newtok – get the momentum going for relocation

Discussion synopses and recommendations

Data needs and availability

Coordinate agency intervention. Federal and state agencies mandated to provide services and support to communities must coordinate efforts. Failure to do so results in poor situations being exacerbated, for example, USACE constructs a defensive works to temporarily stabilize the coast while other options are explored but the next agency comes along, sees the new, apparently available land and builds a runway or school on it.

Coastal efforts clearinghouse. Related to the previous recommendation and a point that came up on several occasions is the need for a central coastal project clearinghouse that would provide a "one-stop shopping" to enable agencies and academic groups to better coordinate efforts with that already going on and to obtain relevant information and datasets. A primary use would be to provide information to support estimates for the cost of shore protection. Such a clearinghouse would probably need to be maintained by the state, although AOOS and GINA are options (below). Sexauer noted that the USACE Baseline Assessment has been a useful tool to gain at least a broader overview. McCammon stated that the Alaska Ocean Observing System (AOOS) routinely ingests a wide variety of data on an operational basis and that they might be able to serve to house a project clearinghouse. Further, the original goal of AOOS is to consolidate information on the coast and ocean. AOOS also houses the Alaska Marine Information System and is a good site for public information on coastal issues, such as coastal erosion. The Geospatial Information Network of Alaska (GINA) is another potential clearinghouse site.

Environmental monitoring. More monitoring of environmental forcing is required to improve the bases on which intervention designs rest and to better understand the lifecycle progression of intervention and defensive works. For example, USACE would like to see more wave data from Shishmaref. However, Sexauer noted that USACE Alaska District has no authority to enact research and development except as authorized on a case-by-case basis to very directly support projects. Monitoring and data-acquisition activities need to target the following:

- Environmental forcing: wind, waves, and water levels
- Bathymetry, topography
- Monitoring of shoreline position
- Photo monitoring (e.g. camera array at Seward, monitoring work on Beaufort coast)
- Sediment budget

Sediment budgets/shoreline mapping. Smith indicated that sediment budget analysis is standard operating procedure in every state but Alaska. This activity should be initiated as an additional way to monitor erosion and to provide mass transport data for engineering intervention work because many engineered works alter the sediment supply. Detailed ground truthing work is also required with site visits to determine, for example, sediment characteristics.

Demonstration/pilot project. Many at the meeting favored initiation of a demonstration project that should be conducted by the Corps of Engineers and which directly contrasts the response of different engineered intervention options on a stretch of coastline. A series of locations should be selected to best represent the diversity of coastal types around the state. Locations were not easy to identify at the meeting and would require another, focused meeting.

US Army Corps' statewide study. The USACE AK district has a funding commitment to establish an online database of erosion assessments. It is their intent to visit as many as 50 communities in 2007, starting with the lower Kuskokwim and Seward Peninsula. The essential question being asked is will villages have the same standards for erosion control? The Corps is also working to improve their rapport with communities, e.g. to combat the observation that "…the Corps comes in, then leaves…".

Education and outreach

Science and engineering advisory committee: A standing committee/commission for addressing coastal erosion issues should be struck, possibly formed to advise Denali Commission. The coastal zone management community is an existing forum with a clear stake; this region encompasses many other concerns peripheral to erosion problems.

Additional information for intervention cost estimates. A form of education is to help people understand how intervention cost estimates work. That is, a $100M estimate to move a village is not all upfront in one amount, but is an overall, long-term cost estimate. When decision-makers see these sorts of numbers without additional context it inhibits action. Thus more complete information concerning the costs of various options must accompany the cost estimates. This might make relocation cost estimates a little less of a lightning rod and enable more work to proceed.

Develop classroom material.

Format: The principal instructional format discussed was a video. Target audiences are varied and include schools but there is also an important general public audience that needs to be served because they are the people who keep building in harm's way. Specific groups include:

o Schools – K-12
o Schools – college level
o General public
o Coastal managers, Planners
o Real Estate agents
o Borough officials

Venues: Venues for dissemination include simple hand-outs, e.g. to schools and individuals, and airing it on TV in a 10 minute Public Service slot on KUAC-RV (Alaska 1). In terms of production Frank Chythlook, a Fairbanks-based videographer from the Bristol Bay area with a lot of documentary experience, came up with a rough costing to produce a video (~$25,000). He emphasized that the use of local languages is a must.

Material: The focus material would depend on the target audience but would be either thematic, e.g. this is how coastal erosion works, here are engineering options, etc., or geographical, which would focus on case study of a given location. The latter option might be of greater use to villages. A case study of Newtok's relocation efforts, for example, along the lines of the session conducted at the Alaska Forum on the Environment in February 2007, would be a good contribution.

A general list of ideas for video topics mentioned a the meeting include:
o Profile case studies
o Also for kids
o Alaska coastal environment
o Historical photos showing change
o Possibly use Sea Grant-sponsored book pending (Orson Smith & Mike Hendee)
o Point out human-caused exacerbation
o Promote no adverse impact approach to coastal regulation
o Target policy makers
o Possible Sea Grant support

*Establish short courses and seminars.*Short training courses, e.g. half-day, single day, and/or seminars should be developed and offered. The course would center around erosion hazards and coastal responses, but the specific contents would vary depending on the target group. A key would be lots of visuals. In terms of target venues, it was felt that this would go over fairly well as offerings bundled with larger annual meetings that are attracting a wide audience to begin with. Ideas included:
o ACMP – AK Coastal Management Program
o Piggyback on IGAP (Indian Environmental Assistance Program)
o AELS – Board of registration for Alaska Engineers
o AK forum on environment
o Science to Engineering workshop – interest in transiting this to short course
o Alaska Federation of Natives
o Alaska Native Science Commission
o UA system distance delivery
o Coastal zone managers
o Alaska Municipal League
o Sally Cox's group in Juneau (DCED?)
o Alaska Forum on the Environment

Other communication vehicles: Other means of disseminating information were discussed at the meeting and included:
• Brochures, booklets, handout pamphlets, flyers, posters
• Speakers Bureau – coastal erosion specialists/experts
• Continuation of topic at UAA annual January workshop
• Professional development courses for engineers and planners
• Online forum (http://forum.iarc.uaf.edu)
• Patty Burns (Ak GS)
  o Web site has some info
• Land-owner-targeted education
• Use internet; ubiquitous

Additional Resources
UAF IPY website
USACE etc webpages
Publications (Orson's UAA workshops)

Workshop participants

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